

We claim:

1. A method of segmenting a media signal for parallel watermarking operations, the method comprising:
sub-dividing the media signal into segments;
5 distributing the segments to parallel processors; and
performing parallel digital watermark operations on the segments in the parallel processors.

10 2. The method of claim 1 including:
analyzing a media signal to prioritize segments of the media signal for digital watermark operations on the segments.

15 3. The method of claim 2 wherein the media signal segments are prioritized for digital watermark embedding operations.

4. The method of claim 3 wherein the media signal segments are prioritized such that segments that are more likely to carry a readable watermark signal are given higher priority for the embedding operations.

20 5. The method of claim 2 wherein the media signal segments are segmented and prioritized by color.

25 6. The method of claim 2 wherein the media signal segments are prioritized for watermark embedding based on analysis of the media signal that indicates the printing distortion expected for the segments.

30 7. The method of claim 2 wherein the media signal segments are prioritized for watermark embedding based on likelihood of watermark survival through rendering, compression or transmission distortion.

8. The method of claim 7 wherein the watermark embedding is limited to a predetermined resource constraint limiting amount of watermark embedding before transmission, rendering or broadcast of the watermarked media signal generated by the watermark embedding.

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9. The method of claim 1 wherein the media signal is segmented spatially into contiguous blocks for parallel watermark operations.

10. The method of claim 1 wherein the media signal is segmented into plural different resolution signal segments, and parallel watermark operations are performed on the plural different segments.

11. The method of claim 1 wherein the media signal is segmented based on processing bandwidth available for the watermark operations.

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12. The method of claim 1 wherein the media signal is segmented and prioritized for watermark operations based on a mask used to control the watermark operations.

13. The method of claim 12 wherein the media signal comprises an image and the segments are prioritized for watermark embedding or decoding based on a color component mask.

14. The method of claim 1 wherein the media signal is segmented into blocks based on a memory parameter of processing hardware.

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15. The method of claim 14 wherein the memory parameter comprises a unit of memory used to swap data into system memory in a virtual memory system.

16. The method of claim 14 wherein the memory parameter comprises a memory alignment boundary.

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17. The method of claim 1 wherein the media signal is segmented and prioritized based on bit plane to reduce the number of bit planes of the media signal subjected to watermarking operations.

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18. The method of claim 1 wherein the media signal is segmented and prioritized for parallel watermark decoding operations based on probability of watermark detection.

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19. The method of claim 1 wherein the parallel processors comprise threads of execution on one or more hardware processing units.

20. The method of claim 1 wherein the watermark operations are performed by two or more watermark operation modules, and the watermark operation modules
15 operate in parallel.

21. The method of claim 20 wherein the watermark operation modules comprise a watermark generator, a perceptual analyzer and a watermark applicator.

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22. A computer readable medium on which is stored instructions for performing the method of claim 1.

23. A distributed digital watermark embedder comprising:
a watermark signal generator for generating a watermark from a message;
25 a perceptual analyzer for perceptually analyzing a media signal and generating perceptual control parameters used to control application of the watermark to the media signal; and
a watermark applicator for receiving the media signal, the watermark and the perceptual control parameters, and for applying the watermark to the media signal
30 according to the perceptual control parameters; wherein the watermark signal

generator, the perceptual analyzer and the watermark applicator operate on distributed processors.

24. The embedder of claim 23 wherein the distributed processors comprises
5 independent threads of execution.

25. The embedder of claim 23 wherein variable watermarks are embedded in
copies of a media signal by executing the perceptual analyzer on the media signal once
to generate a perceptual mask that is re-used by the watermark applicator to apply
10 different watermarks from the watermark signal generator to the copies.

26. The embedder of claim 23 including a media signal segmentation processor
for sub-dividing a media signal into segments for parallel processing in the embedder.

27. The embedder of claim 26 wherein the embedder includes plural perceptual
15 analyzers, which operate in parallel on segments of the media signal.

28. The embedder of claim 26 wherein the embedder includes plural watermark
signal applicators, which operate in parallel on segments of the media signal.
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29. A system for parallel watermark embedding comprising:
a media signal pre-processor operable to receive a media signal and divide the
media signal into segments for parallel watermark embedding operations; and
a server for distributing the segments to parallel processors for parallel
25 watermark embedding operations.

30. The system of claim 29 wherein the segments are prioritized for embedding
operations.

31. The system of claim 30 wherein the segments are prioritized for embedding
30 operations based on readability of a watermark.

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32. The system of claim 30 wherein the segments are prioritized for embedding operations based on hardware resource constraints.

5 33. The system of claim 32 including a load balancer for distributing segments to the parallel processors based on priority.

34. A batch digital watermark registration and embedding system comprising:
a network interface for receiving ID registration requests, the requests including
10 a list of media signal files and information to be linked with the media signal files via data embedded in the media signal files;

a batch registration loader for creating records in a registration database corresponding to identifiers for each of the media signal files;

a batch registration extractor for reading the registration database and creating
15 an embedder control file, including identifiers, a corresponding list of media signal files, and embedding instructions for controlling embedding of the identifiers in the media signal files; and

a parallel digital watermark embedder for segmenting media signal files into segments and for distributing the segments to parallel processors for performing
20 parallel digital watermark embedding operations on the segments to hide the identifiers in the media signal files.

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